

FROM THE AUTHOR.

ON PROGRESS  
AT KING'S COLLEGE;

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AND ON THE

NATURE OF LIFE.

INTRODUCTORY TO HIS FORTY-FIRST COURSE OF  
LECTURES, DELIVERED AT KING'S COLLEGE,  
OCTOBER 6TH, 1893.

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PRINTED BY HARRISON AND SONS.  
OCTOBER, 1893.





## ON PROGRESS.

EVERWHERE we see evidence of the predominating influence of the spirit of progress. Does not the love of progress help to keep nations great, and make peoples happy, self-reliant, powerful and free? Ideas of progress in many new directions have taken possession of the mind of the present generation. So sensitive is our mental state at this time that the thought of the least check, the faintest indication of what may be but a temporary falling back, is regarded with fear, lest the dread decree of the new philosophy, that the weak shall go to the wall, and all not fit to survive shall perish, should be about to be carried into execution. The longing for quick progress in every part of the world leads thoughtful people, from time to time to enquire whether they and all associated with them in work are really progressing fast enough to hold and improve the position already attained, to ensure prosperity, and to render anything like falling back in the future most improbable.

In that smaller sphere occupied by Institutions for teaching, the same effort is apparent, the same struggle to move onwards, and the same fear of

falling back prevails; and the intense desire to improve, to do more in the same time, and to do it better than has been done before, animates all concerned. But though progress marks, and we may hope will continue to mark Institutions and public bodies, there comes a time when each individual worker in turn begins to lose energy if he does not long for tranquillity, time for thought, and escape from the struggle and active work he once loved. All sooner or later grow old, and, successful or unsuccessful, think less of progress than they did in more youthful days. But, strange to say, some ardent scientific men, prophesying the discovery of new potencies, have ventured to assure us that even this great law of nature, that all that lives shall deteriorate and die, shall some day be suspended, or at least for a time, its operation postponed. In that case the most miserable fate ever suggested to perverted imaginations might actually be brought within the range of the possible. Happily, however, there is no reason for such gloomy foreboding, and this, like many other fancies of our time, though masquerading in philosophic garb, is really not worth a thought. But I regret to have to mention that only recently a claim to the discovery of a compound which it is said restores youth to the aged, has been put forward—a claim advanced, I need scarcely say, without a shadow of justification. Nevertheless it is to be feared that some of the very ignorant and the very silly may possibly be deluded and perhaps defrauded.

Among the educational Institutions which I trust will enjoy perpetual youth and repeated rejuvenescence, is our College,—and, if there ever was a session characterised by wise change, enterprise, and progress, it is the present one. Important alterations have taken place in our work, and with perhaps one exception, the natural changes in individual teachers brought about by time have been more than compensated by the addition to our staff of young, active, and talented teachers. In this way the strength of our School has been materially increased. For though individuals wither, Institutions may be kept young and may perpetually advance by the well-timed assistance of the young who surpass their seniors in knowledge, in confidence, in energy, and hope.

Extraordinary progress is everywhere apparent around us in the wonderful increase and diffusion of knowledge among all classes, as well as in the means of teaching how knowledge is to be acquired by teachers and communicated in the best way and at very small cost, or at no cost at all, to the learners. In all this wonderful progress in education the last third of the present century will be prominent. Indeed the extraordinary facility for acquiring every kind of new knowledge, and the very high qualifications of the teachers as well as the extensive arrangements and great number of well equipped Institutions in every part of England is very remarkable in a very remarkable time. We have not only much new knowledge compared with our possessions

of forty years ago, but many of the most important departments of science are practically new. We have a new Astronomy, a new Geology, a new Chemistry, a new Physiology, and new Physics. Of new Natures we have several, and lastly our Philosophy is new, for Philosophers do not assure us that the first principles of a sure philosophy are yet determined so that they will never again be attacked or reversed.

In the real advances of our time, Medicine and Surgery have largely participated. The new powers we now possess are indeed great, compared with those we enjoyed only twenty years ago, while recent progress has rendered it certain that more will be gained year by year. Although we have still much to learn, the improvements in diagnosis and treatment during the past few years have been most marked—while the prevention of disease, almost constituting a new science, will soon be raised to the position of being a very important department of the State. But it is in the treatment of surgical cases that the most striking and immediate benefit to mankind has recently been rendered evident to all by the far-reaching researches of Lister,—till just now our Senior Surgeon,—and their practical value demonstrated in every part of the world.

The only difficulty with which we have to contend as regards the spread of knowledge is the increased and increasing heavy expense thrown upon schools and colleges; but thanks to much private generosity and some public help, this has to some extent been

remedied, and as time goes on it is hoped not only that the difficulty will be removed but that prosperity will reach the teachers, and that they will be fairly remunerated for their arduous and incessant work. So also the introduction of more efficient methods of treatment, and the improved prospect of saving life in many serious cases, has greatly added to the expense of nursing as well as the general management of patients in our public Hospitals, but we fervently hope that the wealthy will help us out of our difficulties as they have invariably done in the past, so that we may be enabled to be of the greatest service possible to the poor who cannot help themselves in serious illness and injury.

And now I must ask you to allow me to refer to changes, in some of which I am personally interested, so that I may explain to you how it happens that I am lecturing here to-day. Enjoying already by some years the longest record of active Professorial work in King's College, and having reached the period of life when old teachers give place to new ones, I delivered at the close of last winter session what I thought would be the last of the many lectures I have delivered during forty consecutive years in King's College, first as Professor of Physiology, next of Pathological Anatomy, and lastly of the Principles and Practice of Medicine. But the Council have otherwise ordered, and have, to my great satisfaction, elected my old friend Professor A. B. Duffin, joint Professor of Medicine with me, thus at the same time lightening my work and responsibility, greatly

strengthening the teaching, and adding to the usefulness and reputation of the Chair. Dr. Duffin, who, as you well know, has been Professor of Pathological Anatomy during the last seventeen years, is succeeded by Professor Dalton, who for many years has been of the greatest service to the School as Pathological Registrar and Demonstrator of Practical Pathology, and I am happy to say will continue to discharge the duties of these important offices as well as those of his new Professorship.

It may be not uninteresting if I trouble you with one further remark about my long connection with King's College, for if to the forty years of my Professorial career the time during which I was a student and school-boy be added, my King's College life will be found to cover the long period of fifty-five years, and it will give you some idea of the excellent hygienic conditions of every part of our College and School, and of this confined part of London, when I tell you that illness has not kept me away from work for a single week during the whole time.

But changes of the greatest importance to the College, the students, and the public have been recently made in the Staff. My old friend and esteemed pupil of physiological days, Professor William Rose, succeeds Sir Joseph Lister as Professor of Clinical Surgery and Senior Surgeon, a position which his great master, Sir William Fergusson, held before him during the later period of his long connection with the Hospital and College, which lasted thirty years.

I am glad to say that we shall still have the advantage of Sir Joseph Lister's care and counsel as a Member of the Council. Every one interested in our School will much regret his absence from our Hospital wards, where such valuable work has been carried on during the past sixteen years; and very many members of the profession here and abroad will never forget their many interesting visits to the Hospital under Sir Joseph Lister's guidance.

Never before, I believe, has such an advance been made in any department connected with the art of healing as that for which we are indebted to Professor Lister, and probably as regards the present and future benefits to mankind, few improvements recorded in medical history will compare with strict asepsis in the practice of surgery. Already relief has been given and life saved in a number of cases that only a few years ago must have been left without help. New operations have been suggested, carried into practice, have become generally recognised, and have been performed again and again by surgeons who but a short time ago could not have ventured to interfere, and probably we have as yet little conception of the advances in medical and surgical treatment which will follow.

Professor Watson Cheyne, who came to King's as Sir Joseph Lister's first House Surgeon, now becomes sole Professor of the Principles and Practice of Surgery, and will by improved methods of illustrating his lectures, and in other ways by increasing the interest of his teaching, add to the already high re-

putation of this chair gained during the past fifty years by illustrious predecessors. Mr. Barrow, a former distinguished student of the College, of whom we are all proud, and who for many years has been a Member of the Surgical Staff of King's College as well as of that of the Royal Free Hospital, now gains the position on the In-patient Staff he has so long merited, and I am glad to say the students will not lose the advantage derived from his teaching of Operative Surgery. Mr. Carless becomes Senior Assistant Surgeon, and undertakes the management of the Skin Department, hitherto under the care of my new colleague in the Chair of Medicine. Mr. Carless will now give instruction in the diagnosis and treatment of this most important and interesting class of diseases. Mr Burghard becomes second on the Out-patient Surgical Staff, and will take part in the teaching of Surgery, and will also give surgical demonstrations.

Another well-known friend who was trained in the College, Dr. Greville Macdonald, has been appointed by the Council to the Throat Department of the Hospital, which has been rearranged and will soon attain a high degree of efficiency under Dr. Macdonald's careful management.

Our colleague Mr. Charles Moss has recently resigned the post of Chloroformist to the Hospital, which he has held to the great advantage of the Institution for the long period of twenty-three years, and I am sure that the whole Staff feel greatly indebted to him for his valuable assistance in this important

duty. Dr. Silk, formerly a very distinguished student and scholar of the College, has been elected his successor as Anæsthetist and Instructor in Anæsthetics, and Mr. G. Rowell Assistant Anæsthetist.

Many of us have long felt that systematic instruction in the administration of Anæsthetics ought to be given to students in the Hospital. The whole subject will now be carefully considered, and arrangements made by which the student will be taught the precautions that should be observed and the means to be adopted in cases in which there may be any difficulty or indications of danger.

And lastly I have to refer to two new appointments on the Hospital Staff, which I need hardly say have given me the greatest pleasure and satisfaction. Not only have I long known Mr. G. Cheatle, one of our new Assistant Surgeons, but his uncle and I were almost contemporaries, while an older relative was a friend of my boyhood. Mr. Cheatle is also on the Staff of the West London Hospital. He has been Surgical Registrar with us, in which capacity he has assisted in surgical teaching in the wards. His work in Professor Cheyne's laboratory has already given promise of some new additions to our knowledge in the field of Surgical Pathology. As regards Mr. Cheatle's colleague, who has also been for some time a member of the Staff of another Hospital, the Great Northern, as well as for two years Demonstrator of Physiology in this College, I may be permitted to express the gratification I feel, and so seldom experienced by an old teacher fast approach-

ing the close of an exceptionally long and happy teaching career, on the occasion of my son being elected as a colleague upon the Staff of the Hospital in which all the active years of my life have been spent, and upon being, as it were, thus permitted to live over again the early years of life, and for a second time to enjoy happy prospects, interests and hopes, and the promise of progress in scientific and professional work.

#### LABORATORY AND TUTORIAL TEACHING.

In no department of modern medical education has progress been more marked of late years than in the increase of practical training; and in King's College we have made great improvements in this direction, especially as regards the early years of studentship, in Physiology, Histology, Biology, and Chemistry, as well as in Anatomy. Much greater importance has been given to this practical part of the work than was usual in former days, and now every student is taught in the laboratory and work room as well as in the lecture theatre, the dissecting room, and the museum. Of this new part of the training every advantage should be taken. From the time he enters to the completion of his five years' course, the student is taught practical methods of examination and observation, and if so inclined he can learn how original scientific enquiry is carried out and take part in new researches. Not only so, but there are many scholarships to encourage him in the prosecution of original research, and well equipped labora-

tories and work rooms where he may prosecute new enquiries free of expense. The advantage of laboratories and work rooms in connection with medical work and progress was however fully recognised more than forty years ago, and I well remember the time when Dr. Marcet, Dr. Thudichum, and myself had our own private laboratories arranged for working and teaching. It was in this way I began in a house adjoining the Hospital in 1852, and among my pupils of those early days, in Medical Chemistry and Microscopical Investigation, were several examiners, some teachers, as well as many students who afterwards held important appointments. This work went on for seven years, and during the later part of this time my laboratory was carried on in connection with the Chair of Physiology in King's College, to which I was appointed in 1853. In those days there was no Thames Embankment, and the palatial laboratories and work rooms of the present Professor were represented by a dark little cellar about six feet by ten, and this was the only work room in which the first four Professors of Physiology in King's College had to prepare specimens to illustrate their lectures.

Besides useful additions to and improvements in many of the large laboratories, the Chemical, the Physical, Lady Siemens' magnificent Electrical Laboratory, and the Physiological and Biological Laboratory; that for Practical Toxicology Hygiene and State Medicine, Prof. William R. Smith being Director and Messrs. Huntley and Attfield, Demon-

strators, has been increased in efficiency, and recent arrangements have been made for all teaching required by those who intend to devote themselves to sanitation, and desire to obtain the Diploma for Public Health, as well as for the Instruction of Sanitary Inspectors. The large Bacteriological Laboratory founded by the Prof. of Comparative Anatomy and Bacteriology, Professor Crookshank, is in excellent working order, and many practitioners and students have taken advantage of the Practical Instruction afforded by the Professor and by Dr. Hewlett. In addition to the above we have now in active operation Professor Cheyne's Laboratory connected with the Chair of Surgery, of which Mr. G. Cheatle is Demonstrator, Dr. Ferrier's Laboratory of Neuro-Pathology, Dr. W. A. Turner being Demonstrator, and the Botanical work room under the management of Professor Bottomley, the new Professor of Botany, who follows Professor Groves, who I regret to say is not able longer to continue to help us with the useful work long conducted by him with great advantage to the College.

Our laboratories and work rooms for practical study are now a feature in the College, which has been very fortunate in receiving the assistance of many warm friends. By the munificence of City Companies and the generosity of some deeply interested in the progress of learning, art, and science, our old laboratories and work rooms in all departments, have been greatly improved, enlarged, and increased in efficiency. In the last Report

presented by the Council to the Annual Court of Members of the College on May 12th, 1893, will be found the following important observations : " Those who have known the College longest, and most intimately, can testify that there never was a time when it was doing so much important work, or doing it better. Its activity is extended year by year to fresh fields of work. Within the last ten years a sum of not less than £30,000 has been expended in the provision of new laboratories, or in the improvement of old ones, and the energies and devotion of the Staff of the College are more than ever conspicuous."

Another improvement connected with tutorial teaching, which the Council and Professors have long been anxious to introduce, has been recently carried out. Members of the staff generally take part in this important method of conveying knowledge, particularly in connection with clinical work, but arrangements have recently been made by which students may study day by day more systematically in the wards as well as in some of the laboratories and work-rooms. My old friend and respected teacher Sir George Johnson, one of the best and fastest friends of the College, who I regret to say is now not in good health, was appointed Medical Tutor in 1843, and I believe he was at that time the first tutor in a medical school. Of late years we have had the advantage of the valuable assistance of several distinguished men engaged in this branch of teaching, and now that the number and

range of the subjects required, as well as the severity of the examinations, have so largely increased, good tutorial teaching in every subject has become a necessity.

You will find tutors and demonstrators ready to assist you in your studies, and especially during the early years of training, in Anatomy, Physiology, Chemistry, then in Clinical Medicine and Surgery, and in Practical Surgery and Pathology, Bacteriology, Neuro-Pathology, State Medicine, Hygiene, and Toxicology, in Ophthalmology and Aural Diseases, Diseases of the Skin, and in Throat Diseases. The Sambrooke Registrars, the House Physician, and Assistant-Physician Accoucheur, are all ready to assist the student day by day in his work. Our general clinical teaching has been strengthened by the appointment of Dr. Whitfield as Tutor in Clinical Medicine, and Mr. E. R. White as Tutor in Clinical Surgery. Owing to our Medical Faculty being a constituent part of the College, we have, among many other advantages, that of access to one of the best equipped Physical Laboratories in the country, which is presided over by Professor Adams, and where Messrs. Heroun and Jackson are of great service to many of our students by instructing them in Experimental Physics and in various departments of Practical Physics. We all hope that of those who join our School, many will succeed in learning how to observe and to think for themselves, and that when their training is completed they will learn how original investigation is carried out, so that those of

you who have inclination and opportunity, will be able to take their part in advancing and extending medical knowledge.

No one who has learnt and taught in the same Institution during more than fifty years can look back upon the many changes referred to, in not a few of which he has participated, without feeling great interest and recalling the many teachers and friends of his youth, and his many pupils and friends of his age. He naturally contrasts the less perfect training for medical work in his student days with the far more efficient and elaborate system of this time.

When I began in 1845, and for many years afterwards, three years were regarded as the proper time for the complete education of the medical student. Students have now the advantage of a five years' training—not unnecessarily long when we consider the enormous increase of fact knowledge required. The training is more complete and thorough, and the average student is far better prepared and qualified for his professional duties.

This brings me to the end of the long list of progressive changes, vital and material, which have recently been sanctioned by the Council. We may be sure that such indications of progress in our means of teaching, and the help that will be afforded by the many new and zealous members of our staff, will enable our College to retain the advanced position it has held among Institutions for the higher education of men and, from 1879 for women, ever

since its early days, when it was one of the very few Colleges in the country having similar aims.

Every kind of teaching required in these days of progress is now carried on within these walls, for the benefit of pupils from the age of eight to the age when the capacity for learning fails. The greatest efforts have been made to make our College and School worthy of the London of our time, and in this work the Council, the Principal, the Staff, and in our department the most active and deservedly popular of Deans, have taken active part. All look forward to increased prosperity and uninterrupted progress in the years to come.

#### RELIGION AND SCIENCE.

I shall next ask you to consider with me some points which bear upon a large question of serious consequence to us all, and one which is being, and has been, much debated, and concerning which contrary views are entertained and taught. Never, probably, were the first principles of religion more discussed and called in question than at this time. The influence of scientific discovery upon religious views has always been to me a study of surpassing interest, and there are some aspects of the varying relation of science to religion that have not yet been adequately treated. I cannot but feel that the views advanced and taught by not a few who have gained scientific distinction, and who therefore exercise authority and influence on the thought of the time, like some other views upon highly important ques-

tions of another kind, though repeated again and again, are not supported by well ascertained facts, are even contrary to reason, and in the present state of our knowledge quite untenable. They are not really in accord with the tendency of the thought of our day, though the contrary is often affirmed, and in the very strongest language.

The general question whether religion should be taught to the young has been much contested of late, and the opposition has been so strong that it is not surprising that a considerable number of thoughtful persons have been led to conclude that concession was expedient, although they themselves not only retain their belief, but in various relations of life advocate and support the religious views they have held from childhood, and to sustain which they are even ready to die.

The new wave of anti-religious feeling which just now afflicts a great part of mankind, will no doubt subside after a time, like many preceding waves of the kind. We shall find that many of the assertions by which people's minds have been influenced rest upon assumption only, and are actually inconsistent with many scientific facts. But the most serious thing in connection with this painful controversy is that men who differ from one another in their views of religious teaching, while agreeing in essentials, should run the risk of encouraging by their differences a small party condemning all religion, and not distinguished for knowledge, good judgment, discernment, generosity or common

sense, in the making and passing of new laws adverse to religion, and this notwithstanding those who agree that religion should be taught, constitute an enormous majority.

Looking from the practical side we ask what should be taught to the young if it be decided that they shall not be instructed in religion? Are they to be told that nothing has been made by God, but that things have been formed by evolution, that there is no God, no Design, no Power above matter, no Director, no Superintending Providence, but that all is due to Cosmic process only, and that all was once Cosmic dust, and that all will become Cosmic dust again?

The curious demand that morals shall be taught without religion, and the progress of secularity in recent years, indicate that the time is supposed to be ripe for a tremendous change in view to be pressed upon the public, and a struggle made to carry it. We shall soon be face to face with the contention that little children are to be educated without any religious teaching in the schools, because a so-called liberal party professes to have been convinced that miracle of every kind has ever been, is, and will continue to be impossible, and therefore decrees that in future no one shall be allowed to teach anything that is contrary to this view. But the possibility of miracle has not been and cannot at present be disproved from the science side. So long as we remain unable to show precisely how a particle of matter in the living state differs from the

same matter when it has ceased to live, it is not easy to understand how we can declare that in the present state of scientific knowledge we are justified in concluding that the relation between life and Infinite Power is essentially of the same nature as that which subsists between mere non-living matter and the Infinite. As men learn more concerning the facts of nature, they will be less influenced by the arbitrary dicta of those who profess to know more than average mortals concerning the unseen and unknown, the intangible, the imponderable, the unknowable, the absolute.

Seeing that the enormous majority of intelligent mankind still believes in religion just as their predecessors have believed for centuries, it is very strange that the opponents of religion do not endeavour to clearly state the facts and arguments which have influenced them. All attempts to upset the first principles of religion from the science side have hitherto entirely failed, and the only persons who profess to be convinced by the arguments are probably those who were convinced before any arguments were put before them.

The growing popularity of the purely secular view as far as I am able to make out is mainly due to the impression so widely disseminated of late years that recent scientific discoveries in connection with the present and past state of the earth have rendered untenable views and doctrines taught and believed as true only a few years since. Moreover the impression gains ground that new and sound

arguments have been accepted which are based upon facts of science only now revealed for the first time in history. And the notion is widely prevalent that as it is only within the last few years that successful scientific investigation could have been carried on, because the means of enquiry were not known to our predecessors, the force of new conclusions solely depends upon the new knowledge which was not obtainable before our time; and that therefore as regards the bearing of scientific facts upon our religious views we are in a position altogether new. For this reason it is suggested that the facts and teachings of history can have little bearing upon the matter. Tradition is not to be considered—we are to break altogether with the past. If we receive the new knowledge as interpreted by scientific privileged authority, darkness, doubt, and confusion will be succeeded by illumination, and understanding and progress will attend us. Nature present and past and future are for the first time revealed, and the secrets of the Universe for the first time shall be laid bare.

As is well known, through all the changes and improvements introduced since its foundation in 1831, the Council and Staff of King's College have firmly adhered to one principle which actuated its founders. Believing "that every system of general education for the youth of a Christian community should comprise religious instruction in the Christian religion," it was determined that the doctrines and duties of Christianity, as inculcated by the Church of

England, should be taught in the College. Probably we are the last, or nearly the last, of the Colleges of our Christian country that adheres to such teaching as a part of its system. On this account we are considered by some in these days as unreasonable and behind the times, and our system has been assailed, but on this account only, as being narrow and sectarian. Looking however from the side of science no convincing arguments can be found for this opinion. Surely the opponents of what is called denominational teaching as conducted in such an Institution as King's College should explain the precise grounds of their opposition. In what particulars do they consider that we are narrow, unreasonable, or behind the time—illiberal, prejudiced or opposed to new knowledge, and not deserving of the help given to other Educational Institutions ? Undoubtedly some of the minds claiming to be most advanced are against us, but whether such minds are really advanced is another matter. What is the evidence of the advance claimed for the minds in question ? That some of them are very confident, very authoritative, and perhaps even a little arrogant, is true. Such minds are also more prone to dogmatism than is consistent with their pretensions, and while they claim to be influenced and to influence others by reason alone, they try by every means in their power to persuade and convince. Not a few opponents claim to be agnostic, although it must be obvious to all, from their bearing and the manner in which they express themselves, the agnostic attitude is contrary

to their very nature, while infallibility in general seems to be perfectly natural to them. For example, "all living things are machines" has very little of the true agnostic ring about it. It has been repeated again and again, but in what particulars living things resemble machines, what particular living things are referred to, and in what particulars any machine to be seen exhibits a likeness to any living thing, has never been stated. Why not point to one particular living thing and say in what respects it is like some particular machine, so that those who are unable at present to see any likeness, may re-examine the living thing and the machine, and endeavour to find out where they have been in error, and how they failed to see the resemblance in question.

No doubt the great progress in every department of science has led many to conclude that the relation between science and religion has of late years been entirely changed. The notion that scientific discovery had rendered necessary modifications in many doctrines that were but a few years ago implicitly believed in, as fundamental religious truths, has given place to a conviction on the part of many that the principles upon which religion is based must be abandoned, that many things hitherto regarded as historical facts and events cannot possibly be accepted in that light, and that actual proof has been afforded of the impossibility of miracle. These and many other conclusions tending in a like direction have been received by hundreds and thousands on the

ground that scientific discovery of a kind never before possible has recently rendered necessary a complete change in view concerning not only the nature, origin, and destiny of man—his relation to other living forms and the cause of his being ; but the very existence of Infinite power has been called in question, and the formation of every living thing in nature said to have taken place without design—without direction,—but yet somehow through the influence of heredity, though heredity has not yet been shown to be one of the properties of non-living matter.

I should not have ventured to address you on this subject had I not felt sure that very strong facts and arguments against the condemnation of religion purely from the science side, had been by some ignored, and had not received the attention they unquestionably deserve from those whose duty it is to support and strengthen religious belief. The time has come when the weakness of the monstrous claims put forward by a small but active party should be carefully examined. Without venturing one word in support or in defence of religion, I have long felt convinced that the supposed antagonism between science and religion did not rest upon substantial grounds, but was rather due to a number of assertions which had been received as if their correctness had been proved, but which could not be said to be founded upon scientific facts, observations, or experiments. It is therefore but right that efforts should be made to put the facts fairly before the public, in order that they

may be able to judge whether the new popular view rests upon the firm foundation of fact as is maintained.

It has been assumed that many new facts recently demonstrated in connection with the non-living world equally apply to life and to all living things, and this assumption seems to be a most important factor in weakening and destroying faith. The contention that the living and non-living are one, has been asserted again and again, and undoubtedly is at this time sometimes believed to be true. The numerous arguments and questionable assertions and conclusions based upon this assumption have been considered in the last edition of my work on Protoplasm,\* and these like the assumption itself seem to me to be quite unjustifiable. The assumption that because we know more about matter and force we must therefore know more about life cannot be sustained, while so far from the new knowledge concerning matter helping us to understand life phenomena, by it these latter are removed farther from the physical category, and shown to be not different in degree, but in kind—absolutely different.

By many it seems to have been forgotten that in science completeness or finality is contrary to experience. Science is always advancing, always changing, always gaining by the results of new enquiry, new experiment, new observation,—ever approaching conclusions, ever advancing towards

\* "Protoplasm, Physical Life and Law: or, Nature as viewed from without." Harrison and Sons.

new ones and correcting some that had been supposed to be final. The solution of some great scientific problem seems ever near, so to say, on the eve of being determined, but alas! it soon is shown to be really far off. In fact, whatever may have been said to the contrary, it is certain that completeness and final solution are inconsistent with the never-ceasing changes which attend progress in almost every department of scientific enquiry. The greater the achievement the more there will be to be achieved. All the changes in scientific opinion, and they are many, which have occurred in modern times have been eclipsed by this purely physical doctrine of life which has been evolved and perfected during the past thirty years, and has exerted a great influence upon our general views concerning the past, present, and future, of all things. This last change in view has never been surpassed as regards the intense eagerness with which of late it has been advocated and forced into popularity ; nor in the momentous consequences which must almost certainly flow from its general acceptance, will it be exceeded by any event recorded in history. If the blessings of Christianity approach even in moderate degree those generally, and with good reason, claimed for it by the best and wisest of every generation that succeeded its foundation, what, alas! must be the consequences to the nations of its abandonment ? Is the physical doctrine of life compatible with Christian belief? But the question at issue is even more portentous, for it is not only belief in Christi-

anity that is assailed, but belief in the God of our fathers has been confidently declared to be impossible for those whose understanding is influenced by reason alone, and who would be guided by pure and simple truth, as enunciated by authority claiming to be scientific.

Is it not part of our mental constitution to endeavour to discover power far beyond the province of non-living matter? The more our knowledge is advanced the more is discovered which requires further investigation, and so the real knowledge of the nature of things seems to recede farther and farther into the distance. The gulf which separates that which is known from that which requires to be known before we can perfectly understand, increases in width and depth. As investigation proceeds, new paths for fresh investigation are opened out, but nothing final—nothing like complete knowledge results. And whether we explore the vastness of space or endeavour to reach the ultimate material atoms in a particle of living matter and study their properties and their relations, we soon lose ourselves; the difficulty remains unsolved, and our knowledge incomplete; so that as it appears to me, nothing has yet been discovered in science which prevents the Christian from still looking back upon the past in the hope of finding unchanged and unchanging perfection. Mr. Huxley, however, still vigorously asserts that “that ecclesiastical spirit that clericalism” . . . “is the deadly enemy of science.” He will probably be alone among

living scientific men in this contention. To bring a charge of this sort in these days is ridiculous, and like beating the air. Where is the evidence? "lively friend" would be quite as correct in the sentence as "deadly enemy."

But religion has been assailed not only from the science side. The opinion that considerable modification of the principles hitherto held to be essential, ought to be made, is not held by scientific men only. For many years past distinguished teachers of religious truth have advanced propositions calculated to disturb and weaken faith. Miracle has by some been regarded as a bugbear, and it has been suggested that it ought to be removed. Only recently it has been said that the Catholic faith should be put "into its right relation to modern intellectual problems" ("Lux Mundi," preface to the tenth edition). The faith is to be "disencumbered, reinterpreted, and explained" anew. In other words, the faith is to be modified in certain particulars in order to meet the altered views supposed to be necessitated by scientific progress. But can the old faith be so modified as to meet the claims urged from the outside? Would not modification follow modification until little or nothing to modify would remain, unless advancing science is only for a time to be attended by advancing faith? But is not faith to be modified as science changes and advances, and are we not therefore expected to look for advanced science to a future so far off as to be of

little interest to us, and only after its establishment, for a more perfect religion? On the one hand the Faith is attacked by the opponents of all religion, on the other it suffers from certain views taken by some of its advocates, which, if broad and generous, are I fear adverse to Christianity.

#### ON THE NATURE OF LIFE.

The opinion that the properties and characteristics of each living thing in nature, and of every living thing that has ever been and that ever will be, are dependent upon the properties of the non-living matter of which their bodies are or were composed, is now widely believed. Indeed, some hold that if the properties of the inorganic matter were thoroughly well known, the properties and characteristics of the living forms to come, might even be premised with certainty; but the data upon which the premise is supposed to rest are of course not stated. The same conclusion as to the competence of non-living matter to produce living forms has been repeated in many ways, and is still entertained. For the last five and twenty years it has been said that everything is material, chemical, physical, and has resulted from the rearrangement of matter alone. In one form or another for years past the public have been persuaded or forced to believe that everything living is but matter, and that all "vital" actions are mechanical and the changes in these actions due to physical and chemical processes only.

The implicit belief in the machine-view of living

things is quite extraordinary. The "animal machine," the "living machine," the "human machine," are phrases frequently met with, although no one attempts to show the supposed points in which the machine resembles a living thing, or indicates the points in common between them. That machines and living things differ as regards construction, origin, growth, composition, capacity of change, mode of action, nature of deterioration, method of repair, and in many other particulars, is quite certain and yet we are expected to accept the machine theory of life. Anyone who is acquainted with the changes occurring during the development of any one organism, whether it be very high or very low in the scale, knows that the several tissues and organs are gradually formed from matter which is formless, and that they grow. But how is the *machine* evolved? Does any part of it grow? Are not all its parts first constructed and then put together? Is any part of any organism thus formed?

The assertion that the formation of any living thing "is a purely mechanical problem," is devoid of foundation. "The machine which we call the human body" (Rede Lecture, June 14th, 1893) is not a machine, for the human body has *grown* and must die, while the machine is made, but has never lived, and cannot die. Assertions of the same kind are legion. "The formation of a crystal, a *plant* or an *animal* is a purely mechanical problem," (!) and yet the crystal can be dissolved and will form again,

while the living thing must be destroyed before it can be dissolved. It is easy to call a living thing "a force-conditioning machine," but impossible to prove any real likeness between any living thing and any machine. Then it has been said that the "machinery" is molecular,—but how can molecules work like machinery, and where is the machine that exhibits the molecular character in any part.

The remark is often made with respect to the probability of mechanism in connection with vital phenomena, that our microscopes do not possess sufficient magnifying power to enable us to form an opinion on this question, and that therefore there may be mechanism, though not to be rendered evident at the present time. But how can there be mechanism in structureless, colourless, diffluent matter, consisting of ninety per cent. or more of water? What arrangement to be called mechanism could permit this diffluent matter to mix, portion with portion, to allow one portion to flow into another portion and intermix? The determination to make out structure is extraordinary; but admitting for argument's sake the existence of networks in living matter, in what way does such a structure help us to explain the facts? Which begins the characteristic phenomena—the network or the clear material in the meshes of the network, and which is the most important? which is necessary or universally present? Living matter or Bioplasm, exists in every organism and at every period of life exhibits the same general characters, and is wherever life is. It is certainly

clear and structureless, neither fibres nor granules nor any structural substance being necessary to its existence. It is impossible to discover from any physical or chemical examination what particular organism the living matter comes from, high or low, or from what part of a complex organism. Nor can any one adequately explain the difference between a portion of *living* Bioplasm, and the same just after it has ceased to live. To say the difference is chemical or physical merely asserts what cannot possibly be true, seeing that nothing that is physical and chemical only, exhibits the properties or powers manifested by Bioplasm, derived from pre existing Bioplasm. A minute portion of Bioplasm not weighing the one hundred-thousandth of a grain may possess individual potency which may manifest itself through hundreds of generations extending over long periods of time. It is needless to say that no matter in the non-living world exhibits potency in any way analogous. To say that the phenomena are due to "cell differentiation," "protoplasmic change," "specific energy," to "immanent energy," or subtle influence, to a physical basis of life, to a vital energy, and that they constitute a cosmic process, explains nothing and teaches nothing. In all vital processes ordinary physical and chemical properties of matter seem to be overcome—to be suspended—to be held in abeyance for a time, while the elements of compounds are being rearranged and caused to take up new positions with respect to one another,

so that the moment vital power ceases to control them, they again obey physical and chemical laws, new and often special substances of remarkable structure and chemical composition being often formed,—but these are no more living than the substances formed in the laboratory.

But the idea that living things are but non-living matter, has been carried much farther than this—and the most extraordinary comparisons have been made between living things and crystals, between growth of living things and aggregation of non-living particles—between phenomena peculiar to life and phenomena independent of life—which occurred before life was. In fact it has been said that non-living things die : “suns and planets die as well as organisms” (Herbert Spencer); but how can that die which has never lived ? That in matter alone is the promise and potency of all life, is another assertion quite devoid of foundation. It would weary you to mention the many more extravagant doctrines, for the purpose of leading people to believe that living things are mere matter; but I may conclude with a few of the most recent authoritative utterances.

After telling the story of Jack and the Beanstalk in the Romanes Lecture for the present year to the University of Oxford, Mr. Huxley remarks that the plant “builds itself up, and then” by degrees withers and disappears from view. This process of going forth and, as it were, returning to the starting point, Mr. Huxley says, “may be likened to the ascent and descent of a slung stone, or to the course of an

arrow along its trajectory ; " " or it may seem preferable to compare the expansion of the germ into the full grown plant, to the unfolding of a fan, or to the rolling forth and widening of a stream ; and thus arrive at the conception of 'development' or 'evolution'" ("Evolution and Ethics," p. 3). The comparison suggests that the stone slings itself—the arrow shoots itself—the fan makes itself and opens and shuts itself—the stream rolls itself forth—just as the plant "builds itself up."

Here is the physical consummation of all things from the first to the last ; and we may hope it will be the last of such shadowy vapourings which emanate from cosmic vapour—are nowhere, and lead to—nothing. "Natural knowledge," Mr. Huxley asserts, "tends more and more to the conclusion that 'all the choir of heaven and furniture of the earth' are the transitory forms of parcels of cosmic substance wending along the road of evolution from nebulous potentiality . . . back to the indefinable latency from which they arose" (Romanes Lecture, 1893). I do not believe that in all science any justification for such conjectures can be obtained. Neither is there any evidence whatever that "natural knowledge" tends as asserted, or ever did tend, or ever will tend, to the conclusion that life has anything to do with "nebulous potentiality" or "indefinable latency," though we may agree with the eminent author of the paragraph, that everything that came from "nebulous potentiality" unquestionably will wend its way back to "indefinable latency." Such an

hypothesis of the origin and destiny of all things can have little interest for us,—all human and intellectual pursuits, hopes and interests being in the ages separated from both vaporous extremes by hundreds of thousands of years and possibly by the immeasurable, the incalculable, the inconceivable.

There is no more reason for supposing that cosmic forces can form a bacterium than that they will account for the origin of human thought. Cosmic process and cosmic forces are incompetent to form any living thing whatever. On the contrary there is as it seems to me sufficient evidence to convince any unbiassed mind that something very different and far removed from anything cosmic is required before a speck of living matter can come forth. This something, whatever it may be called, cannot be included in the category which contains cosmic force, specific energy, subtle influence, and the like. Before the alliance contended for between all that lives and has lived, with the non-living is accepted, it ought to be shown that whenever certain particles of matter are placed under certain conditions a substance appears which builds itself up, which moves itself, which selects from certain substances particular atoms, molecules, or particles—rearranges them or their elements, and communicates to the resulting mass the properties or powers characteristic of living matter. In this way the living matter, unlike matter in every other state, not only increases, but *grows*, and then divides and subdivides into few or many particles, each of which may

grow, and in like manner transmit to more matter the remarkable properties of the original particle, and without loss. Each of these like the first, as far as can be ascertained by the highest magnifying powers at our disposal, is devoid of structure, while every portion is capable of motion, and of penetrating and coalescing with every other portion of the individual particle. Every part of the living moving particle is colourless, and may at once lose all the wonderful properties referred to by a change so slight that non-living matter would not be sensibly affected—while if the conditions remained the same or were modified only very slightly and by degrees, particles may continue through centuries to communicate their powers or properties to matter brought sufficiently near, if of the requisite composition, under the necessary conditions.

Professor Michael Foster in his Rede Lecture on “Weariness” before the University of Cambridge not very long after the Romanes Lecture at Oxford, regrets the little knowledge possessed by physiologists of the “physical basis” of weariness, and, he might have added, of other varieties of physical basis. But if there is to be a physical basis of weariness, why not of strength, of weakness, of health, of sickness, of high and low spirits, of joy and sadness, &c.? This revival of physical basis will cause much weariness to many besides physiologists, who are weary of all “physical basis” as well as of the basis’ allies, Bathybius and his friends. We are further assured

by Professor Foster that "our power to move is at bottom the power of our food to burn, the power which our food puts forth while being oxidised." Here again we have the non-living food *putting forth* power. Is there then no difference between *our power* and *the lifeless food power*? We put forth power, *the food* puts forth power. The *power* of the living body—the *power* of the non-living food—the *power to burn*. Are these powers the same kind of power? Might the word "property" be substituted for power in all these cases, or does power as applied to living matter mean something different from the power exercised by non-living matter, and if so, what is the difference?

The changes in living matter have also been attributed solely to the chemical properties of the substances which constitute the living matter. Undoubtedly chemical change occurs in the internal actions of living matter,—but it is not the occurrence of chemical, electrical, or other form of physical change that is in any way disputed. While it is certain that chemical change takes place, it is equally certain that it does not occur until the elements of the matter about to undergo change have been rearranged or caused to take up certain positions with respect to one another, so that the elements are brought within the range of their ordinary affinities. Now this rearrangement of molecules and elements (?) is effected in a manner which cannot be imitated, and which does not exhibit

any analogy with any laboratory processes, and its nature is quite unknown to the chemist. It is this agent, force, or power, which prepares for, as it were, the chemical change. The confident way in which the necessity for some power in the living matter corresponding to the skilled chemist in the laboratory is ignored, is most curious. One would suppose that chemists had discovered the means of effecting chemical changes in their laboratories without their presence or interference, the work being somehow carried on of its own accord without chemist, chemicals, or apparatus; while the chemicals and apparatus arranged themselves without any knowledge or effort on the part of the chemist.

The chemist is sometimes inclined to boast that he can make some of the highly complex substances characteristic of the living world, but he does not proceed in quite the same way. Study his operations, look at his apparatus, his furnaces, consider the time he takes, the care required, the knowledge, the many chemicals, and think of the long laboratory training necessary before he can successfully make the bodies in question. Then compare all this with what quietly and imperceptibly goes on in the modicum of transparent living moving matter. The constituents are rearranged or rearrange themselves in some definite manner, quietly separating, and at last combining, and at a low temperature, to form, we know not how, the highly complex substances the skilled chemist with difficulty produces in his laboratory.

And now I must perform an act of justice. The cell, or more correctly the living part of the cell, has been compared with a laboratory where wonderful chemical changes take place, where analysis and synthesis are quietly carried out without any disturbance in the parts around, without explosions and without the slightest trace of those odours for which the chemical laboratory is celebrated, and from which it is seldom free. Now in his description of the cell-laboratory the chemist has made an extraordinary omission. After telling us what things are decomposed and what new compounds are formed, and instructing us in the details of the most complex organic analysis and synthesis, we are astonished to find he has effaced himself,—not in his own laboratory or its precincts,—but in his cell-laboratory. He discovers in it no apparatus, no furnaces, no reagents, but alas! there is no chemist, and yet he calls it a laboratory. Analysis and synthesis proceed there in such perfection that the chemist in his admiration forgets the office he himself performs in his own laboratory. What would his laboratory be without his supervision and without his “specific energy”? Imagine the confusion, the chaos, the noise and smoke occasioned by the tendency of his chemicals and apparatus to return to equilibrium.

The chemist in fact is more important than the laboratory. Without him the laboratory would be useless—he is all in all. He designed the laboratory and perhaps constructed it. Without him his chemicals, his apparatus, his arrangements for heating

and cooling, evaporating and drying, would soon become chaotic, without order or arrangement, and laboratory and all would soon be but a confused mass of miscellaneous cosmic substance.

But just as the wonderful power in the living matter which somehow acts as the chemist in the laboratory, has been ignored, so the constructor of the so-called living mechanism, and the engineer of the living machine, who from time to time modifies the action and regulates the pace at which the work goes on, have been neglected. The living watch and clock require no one to wind the spring or pull up the weights, and they repair themselves without the mechanic and without the introduction of new wheels prepared to take the place of the old ones that have suffered by wear.

One of the last authoritative utterances in the same physical direction was by the President of the British Association, who a few days ago spoke of "vital processes" and "vital energies" and "specific energy" without defining what he meant. He finds the "best examples of specific energy" in the most "differentiated," "the highest structures." Evidently "specific energy" has its abode in very complex *structures*, but is there none in the simplest? "Vital energies" "can be split into *processes* which are identical in nature with those of the non-living world,"—but what processes in the non-living world, it is not stated. "Analyzing of a vital process into its physical and chemical constituents,"—but can a *vital* process have physical and chemical constituents?

If so, surely it is a physical and chemical process, and what is gained by calling it vital? But what is it, I would ask, that initiates, directs and controls the physical and chemical changes, and determines the special character of these in different kinds of living matter? What is that in the living matter which effects certain definite and prearranged changes in certain substances, when brought within the range of the influence of this living matter? Does not this something seem to act, or really act the part of the chemist in his laboratory, only more perfectly, more quickly, more directly, and under conditions which would render it impossible for the chemist to work at all, or bring about changes like those taking place in the living matter? If vital energy can "be split into processes identical in nature with those of the non-living world," what is the difference between vital and non-vital energy? Why not call both simple energy? But if energy can itself be split into constituents, how can it *cause* matter to be rearranged—to be split up into new substances? It can hardly be regarded at the same time as operator and as the matter operated upon. More careful study of the chemical and physical molecular changes, and the circumstances under which they occur, will I think convince the mind that something far transcending any physical changes, and of a different order or nature is requisite, before any adequate explanation concerning the simplest life phenomena, will be afforded. The more we know about the non-living, the wider and deeper becomes the gulf

by which it is and has been separated from the living.

#### CONCLUSION.

In all these physical and chemical hypotheses of life, where is the evidence of progress? The hypotheses, or rather conjectures, have been expressed in different language varied from time to time; and many different words, some of rather ambiguous character, and not easy to define, have been employed to make them intelligible, but they are practically fancies, conjectures, and assertions, as they were thirty years ago. We have not advanced one step nearer the proof that life is "energy,"—"immanent," "specific," or cosmic, or due to the properties of matter, or one with cosmic processes, or due to chemical actions, or to machinery of molecular or other character, or to the influence of external conditions, to environment, or tendencies. Moreover there is no evidence whatever of any transition from any form of non-living to any form of living. Life therefore would seem to be far removed from matter and its phenomena, and should occupy a place by itself, and cannot be included in the category of cosmic matter and cosmic processes.

It seems to me that the evidence in favour of the absolute separation between the living and the non-living state is conclusive beyond question, while every attempt to prove the contrary, that the living and non-living are one, or that the non-living gradu-

ally passes into the living state, has signally failed. The nature of life has not been and cannot be demonstrated, but that life power belongs to a category far removed from that in which every form of energy, of chemical action, and of atomic machinery would be placed, seems to me abundantly proved by scientific observation and experiment.

All life from the lowest to the highest—from bacterium to man—at every period of existence from its first appearance on the earth to the present hour, is characterised by changes in matter that is colourless, structureless, mobile, and semi-fluid. Whenever or wherever we study the process of living in the life world we are at once face to face with phenomena which are absolutely different in nature from any phenomena in the non-living world, and which have not yet been adequately explained or accounted for. Much has been learned concerning them, and fact has been, and will doubtless continue to be, added to fact, but the exact nature of the simplest of the phenomena of any kind of living matter remains unknown. Speculation, conjecture, very positive and very careless assertions with regard to tendencies, and prophecies abound, but so far scientific enquiry has failed. The statement that vital actions are mechanical, and the superstition that in living matter, structure, although not to be demonstrated at this time, certainly exists, and will be demonstrated in the time to come, scarcely belong to science. The system of referring the solution of every difficulty to future time, and the daring prophecies of "privileged

spirits" as to what the explanation is to be, are not in accord with the principles of science.

Like many other very general and far-reaching but modern speculations, the hypothesis that science has rendered the acceptance of Christianity impossible from the point of view of reason has attained a popularity which is extraordinary, but what is still more so is that some who accept the hypothesis do not give up their belief. This curious mental state seems to spread. It is associated with, and indeed probably arises from prejudice against a thoughtful examination and consideration of the meaning, import, and consequences of the acceptance of the views in question, arising in part from a conviction that all must allow their minds to be influenced by the authoritative assertions of scientific experts and recognised specialists. But it does not seem to occur to those who take this view, that the instant a prosecutor of science claims special authority he abandons science, which rests upon the results of observation and experiment and recognises no authority. If a scientific man claims privilege to press upon the public what he declares to be the tendency of thought and fails to support it by evidence, he contravenes first principles.

As I have already remarked, the extended observation and more minute investigation of living matter, so far from militating against the acceptance of belief in something superior to and capable of controlling matter and energy, even if it be very specific, clearly indicate that up to this time religious

beliefs are not in any way adversely affected by the latest results reached.

I can never bow to mere authority however powerful on such a matter as this, and dispute authority in science except that which springs from observation, experiment, and the correct interpretation of facts. Now so far the facts of observation and experiment are opposed to some of the most authoritative dogmas about the nature of life, such as—In matter alone is the promise and potency of all life—Matter is all in all—Vital is included among the Physical forces. These and many more assertions in the same direction are still strongly defended, but have not been proved, will not bear debate, but possibly may still serve as the text for certain scientific sermons, as they have already served for many years past.

All the ingenuity, and it has been great—all the speculation, and it has been very ingenious—all the prophecy, and it has been daring, have so far failed to persuade the living particle to reveal its secret. Though the life of man transcends in degree that of an organism so low as the bacterium, as regards the phenomena of the mere matter of the living particles there is much in common. But to say that the life of man transcends that of the bacterium just as the latter transcends the forces and properties of non-living matter is not reasonable, and if gradation be admitted from the bacterium to man, no gradation whatever can be supposed by which the non-living shades into the living. The hiatus has not been

bridged and cannot be bridged even in thought at this time. The difference remains absolute—not gradational.

Who acquainted with the broad facts of microscopic nature, and knowing how little he knows and how much there is that he cannot ascertain, that facts innumerable have long remained as facts without adequate explanation, can allow himself to commit the grievous error of accepting and spreading doctrines to explain the nature and origin of all living things? Who, when confronted with the insuperable objections to the acceptance of some particular doctrine concerning the present or past will nevertheless agree to receive it on the ground that it ought to be accepted and believed until a better substitute shall be found; as if it were the duty of science to explain, correctly if possible, but if not to explain? The only aim of science is to discover and spread the truth, and if truth cannot be found, the followers of science ought surely to maintain an agnostic-scientific attitude until new discoveries are made and new evidence is revealed.

Most of the arguments of the scientific kind against belief in God may be traced to the primary belief in the assumption that the living and non-living are one, backed by ingenious speculations invented for the purpose of convincing people that the facts of life, as well as of nature living and non-living, have been explained by physics and chemistry. It has been argued that since in matter are inherent forces and powers adequate to account

for all forms of life, the idea of a superintending, governing power is no longer needed to explain the facts familiar to us in living nature. But so far from any such life properties or powers having been proved to exist in any non-living matter whatever, and competent to give rise to vital phenomena, the direct contrary remains true, at least up to this very day, and the advocates of the unity of life and non-life have been driven to take refuge in the further assertion that the tendency of thought of the time is in the direction they indicate ; but tendencies are not scientific. No tendency can prove an adequate substitute for facts of observation and experiment, and by these we are compelled in the present state of knowledge to admit the influence in all things living of some force or power above all forces and powers of which there is any indication in any kind of matter that has not been detached from matter already alive, and by these last only can the facts of the living world be accounted for.

Those who profess to hold the physical doctrines of life have been many times requested to fully explain the grounds of their belief, with the only result that the assertions are repeated again and again, perhaps in different and more positive language, a few new words being introduced and old words used in a somewhat different sense, and often a clever and new exposition of an old idea already worked threadbare. But as long as the absolute difference between the world of life and the world of matter remains unshaken, as long as we remain

ignorant of what happens when the living molecule communicates its vital powers to molecules which are not alive, as long as the exact nature of the change when the living particle passes from life to death remains unknown, so long will it be impossible, I venture to think, for those guided by reason to accept arguments and assertions urged against belief in God from the science side.

It seems to me proved beyond question that the matter of every living particle possesses certain characters and exhibits characteristic phenomena, by which it may be distinguished from matter in every other known state. Excepting every kind of living matter yet discovered, there is nothing known that can hand down and transfer to particles of non-living matter, and without loss to itself, the power of rearranging elements of matter in certain definite ways, so that organisms of definite character may be produced generation after generation. The power of giving rise to highly complex beings is, as is well known, for a time associated with a very minute particle of clear structureless semifluid substance, the greater part of which consists of water. It may not weigh the 100,000th of a grain or occupy a space the 100,000th of an inch in diameter, but its *power* may afterwards operate upon tons of material, so that long years, nay centuries, after the original particle, and hundreds and thousands of its direct successors had perished, there would be incontrovertible evidence of its origin, not only as regards broad general characters of the organism but even in reference to

special individual peculiarities by which parent and child might be identified, in some instances for generations. With such powers, properties, potentialities—call them what you will—nothing in the non-living world will compare; nor can any analogy between these and any characteristics of the highest and most complex of chemical substances be pointed out.

In trying to form a correct judgment concerning the all-important question of the nature and source of life, we must be careful to distinguish what *may be* or what *might be* from *what is* capable of proof and has been actually demonstrated. Tendencies of thought, scientific prophecies, and the charming fairy tales of scientific story tellers are for the delight of scientific childhood, and may still be harmlessly enjoyed during the evolutionary period of machine development. But if we allow ourselves to be influenced by facts and reason we must conclude that life is not a property of matter, that the living world and the non-living world are distinct, and that the former was not a natural outcome of the latter, that if all living things were destroyed, the matter of their bodies, and the matter of the non-living world would remain indestructible, but would also remain incapable of giving rise to new life; and that up to this day it has not been shown that fundamental religious beliefs have been shaken, destroyed, or rendered untenable, by the wonderful truths established by the unprecedented progress of scientific discovery in every department of natural knowledge during our time.



LONDON :

HARRISON AND SONS, PRINTERS IN ORDINARY TO HER MAJESTY,  
ST. MARTIN'S LANE.